Preliminary Campbell-Bozorgnia NGA-West2 GMPE for USGS Evaluation

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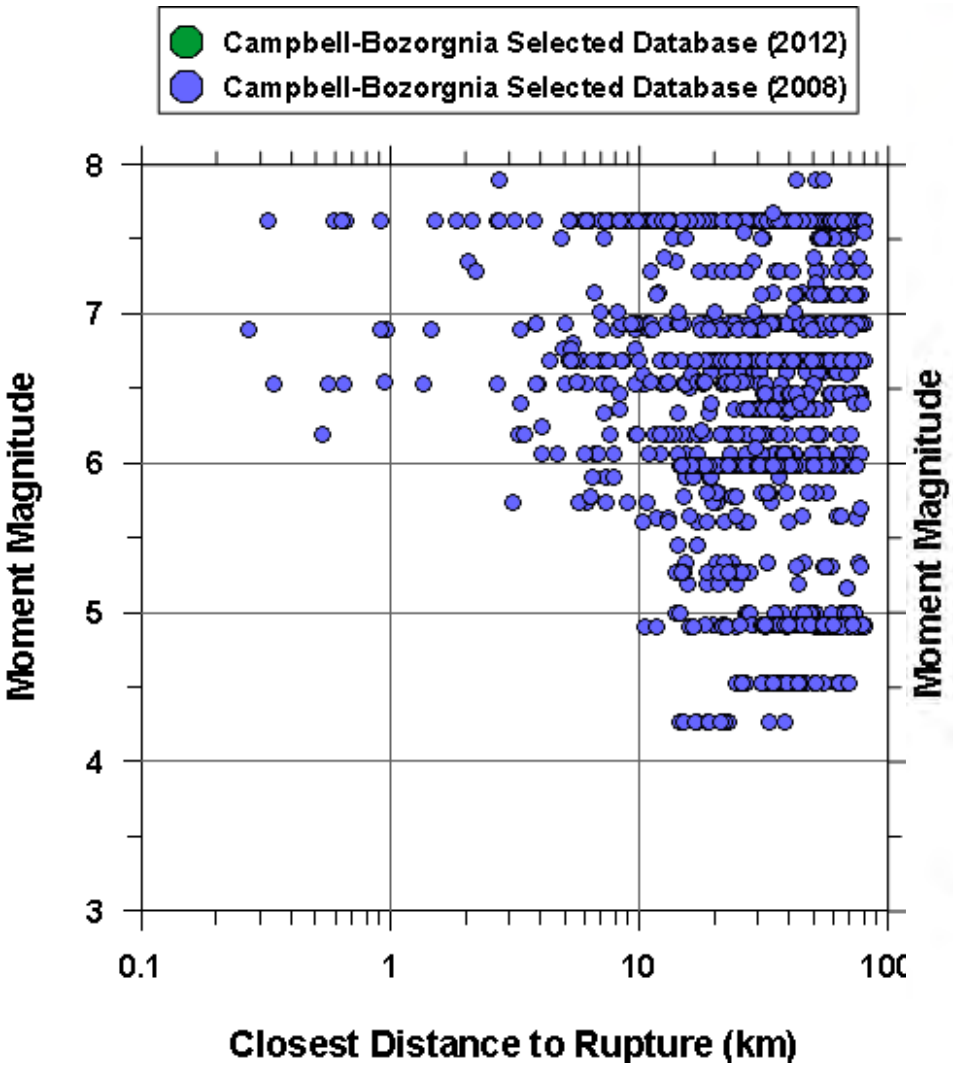
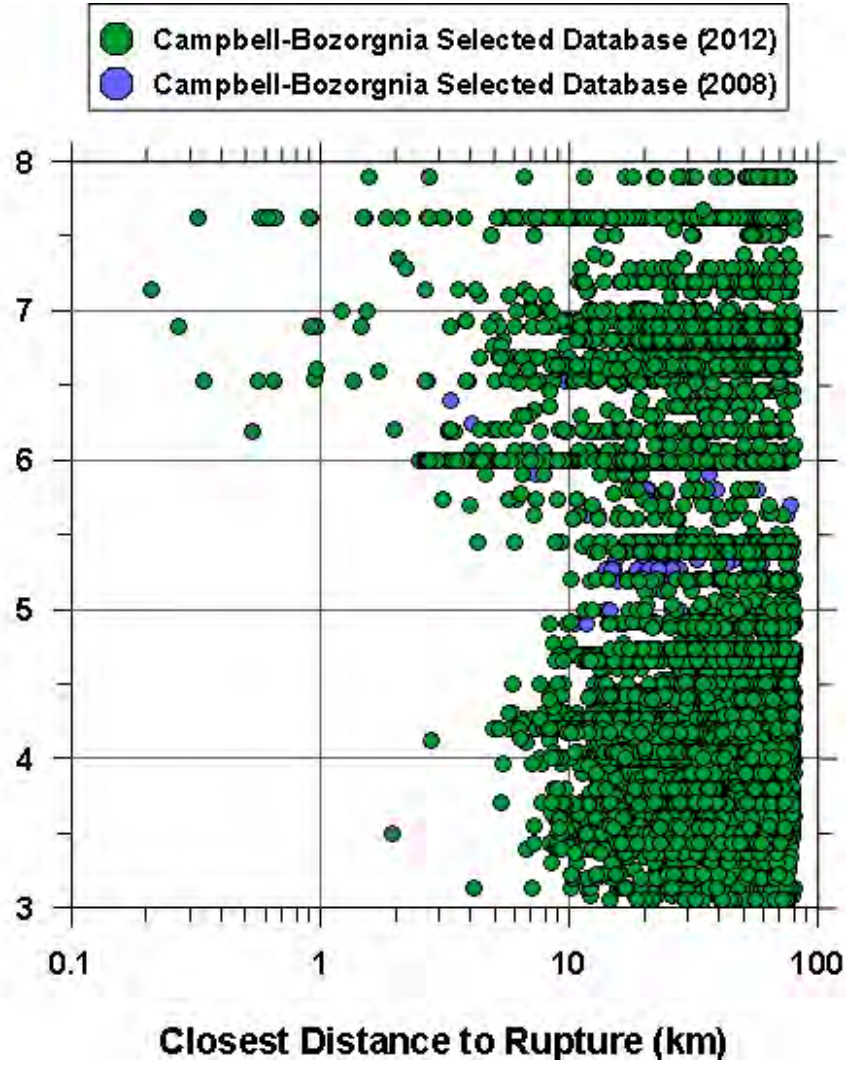
Data Selection Criteria

Data Selection Criteria

- Earthquakes
  - **M** = 3.0–5.5 California events
  - **M** = 5.5–7.9 California and global events
  - Known focal mechanism or fault type
  - Class 1 events using 10 km CR_{JB} criteria
- Sites
  - Free field (shelters, non-embedded bldgs.)
  - V_{S30} known or estimated (via proxies)
  - $R_{RUP} \leq 80$ km (geometric attenuation only)
  - N≥5 (**M**<5.5), N≥3 (5.5≤**M**<6.5), N≥1 (**M**≥6.5)

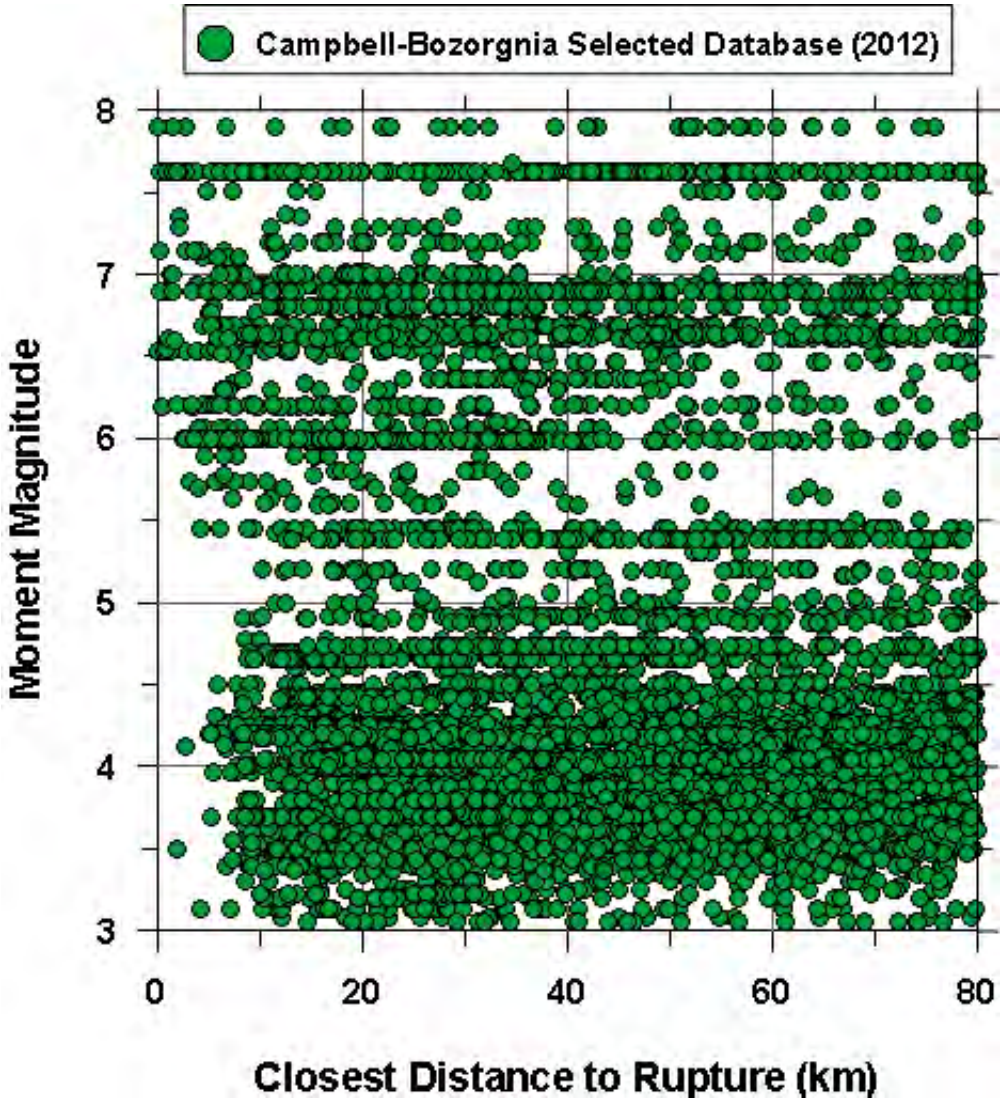
CB08 vs. CB12 Databases





CB08 vs. CB12 Databases

- CB12 data
  - N_{eq} = 280
  - N_{rec} = 6525
- CB08 data
  - N_{eq} = 64
  - N_{rec} = 1561



Changes from 2008 NGA-West1 GMPE

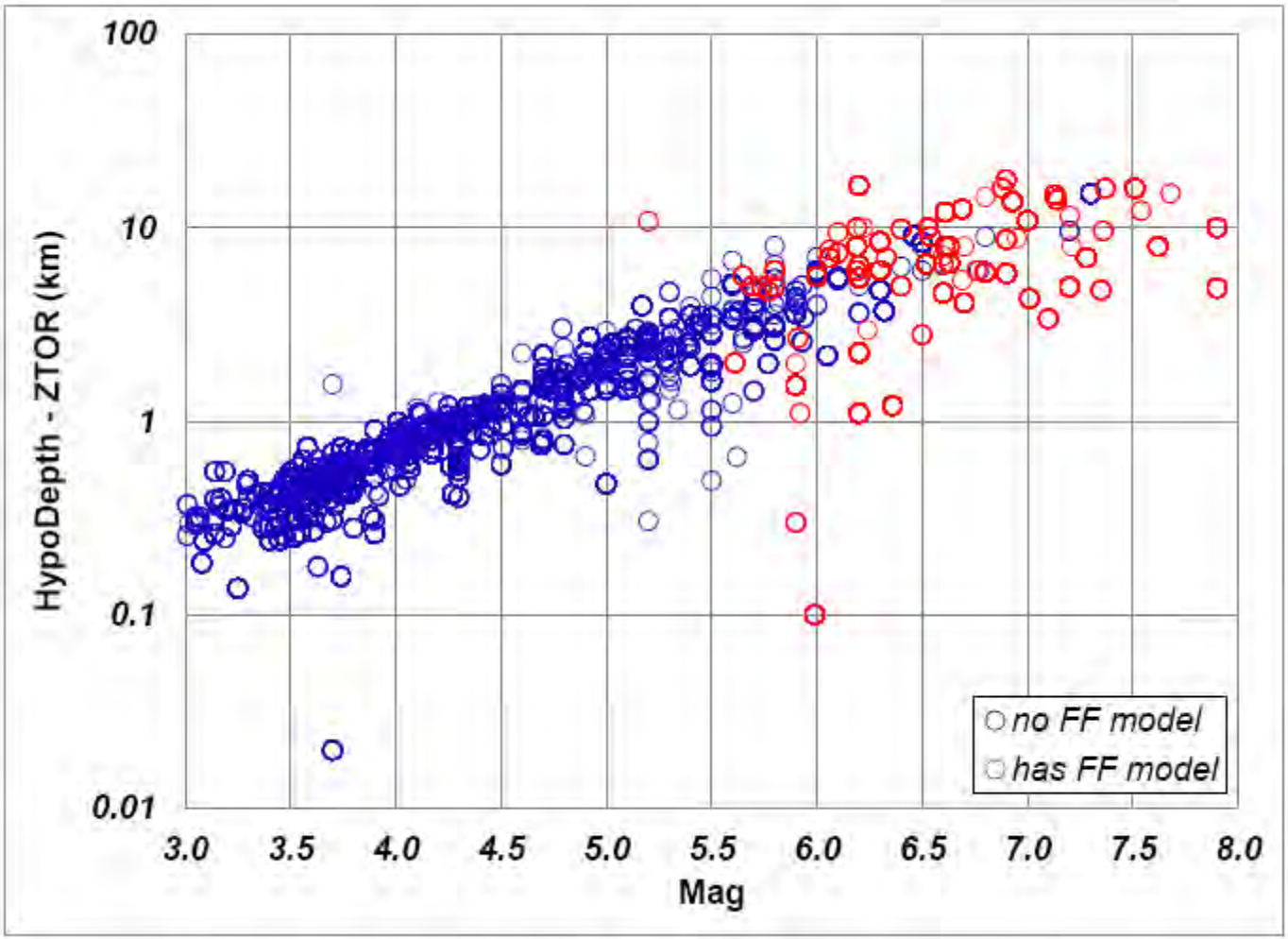
Changes from 2008 GMPE

- Quadralinear magnitude scaling term
  - Additional hinge at **M**=4.5
  - No longer overpredicts small **M**
- Hanging-Wall term from simulations
  - Functional form from Donahue study
  - Function of R_X, rupture dip and width
  - Peaks over bottom edge of fault
  - CB08 distance filter off rupture plane

Changes from 2008 GMPE

- Hypocentral depth term
  - Ground motion increases for H_{HYP}>7 km
  - Statistically preferred over Z_{TOR}
  - Can use $H_{HYP} = f(Z_{TOR})$ proxy (next slide)
- Fault mechanism term
  - No longer depth-dependent
  - Goes away at small magnitudes
- Rupture plane dip term
  - Ground motion increases with dip
  - Goes away at large magnitudes

Changes from 2008 GMPE



Courtesy: Abrahamson, Chiou, Kishida, Bozorgnia

Changes from 2008 GMPE

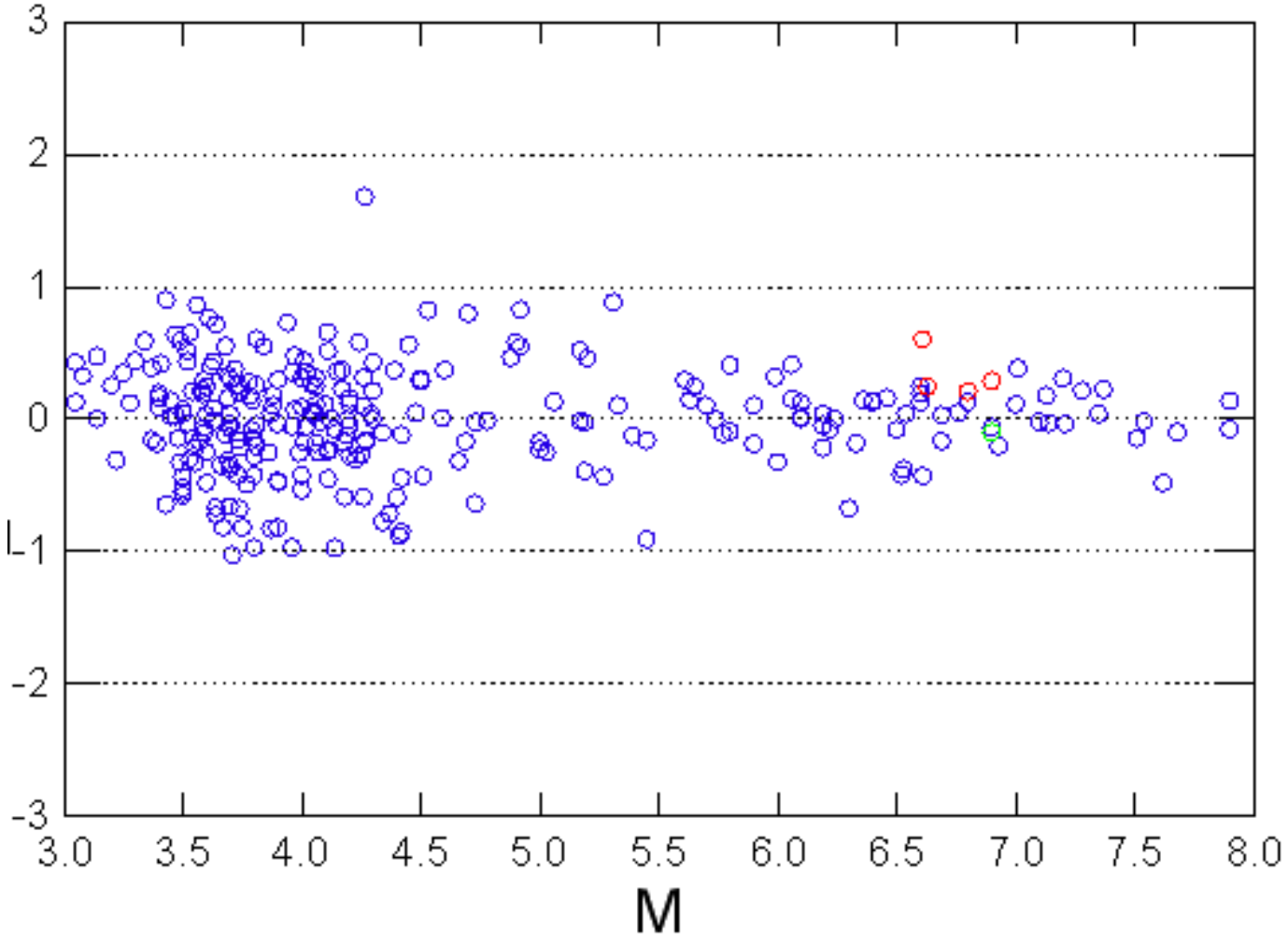
- Shallow site-response (V_{S30}) term
  - Retained Walling et al. nonlinear model
  - Different linear dependence in Japan
  - Japan model bilinear (hinge at 200 m/sec)
- Sediment-depth ($Z_{2.5}$) term
  - California: SCEC CVM-S4, SFBA CVM-08.3.0
  - Japan: NIED Velocity Model
  - Retained Day basin model for $Z_{2.5}$>3 km
  - Deep basin term same for Calif. and Japan
  - Shallow ($Z_{2.5}$<1 km) term differs in Japan

Changes from 2008 GMPE

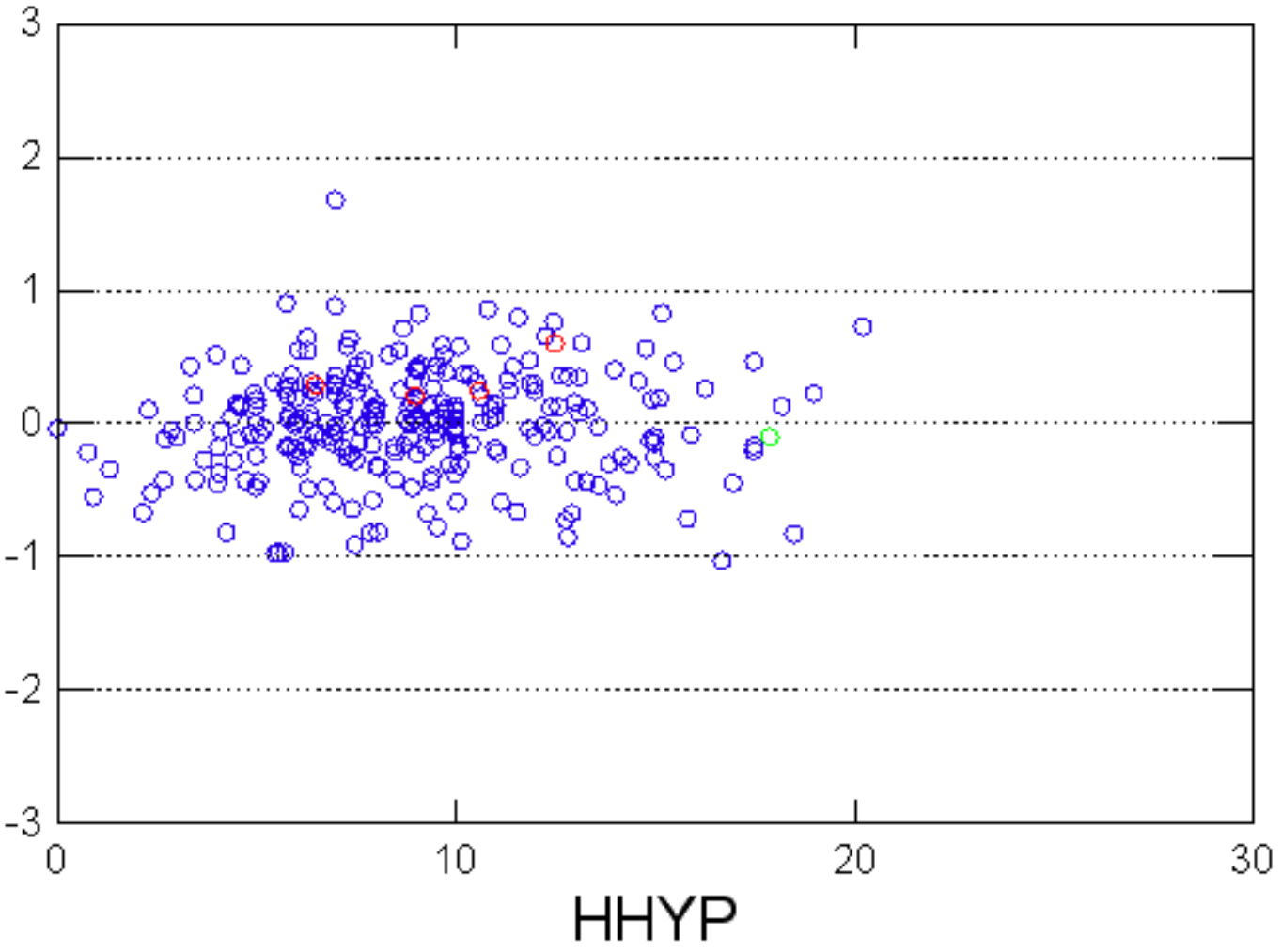
- Standard deviations
  - Similar to CB08 for **M** ≥ 5.5
  - Larger for **M** < 5.5

Distribution of Residuals

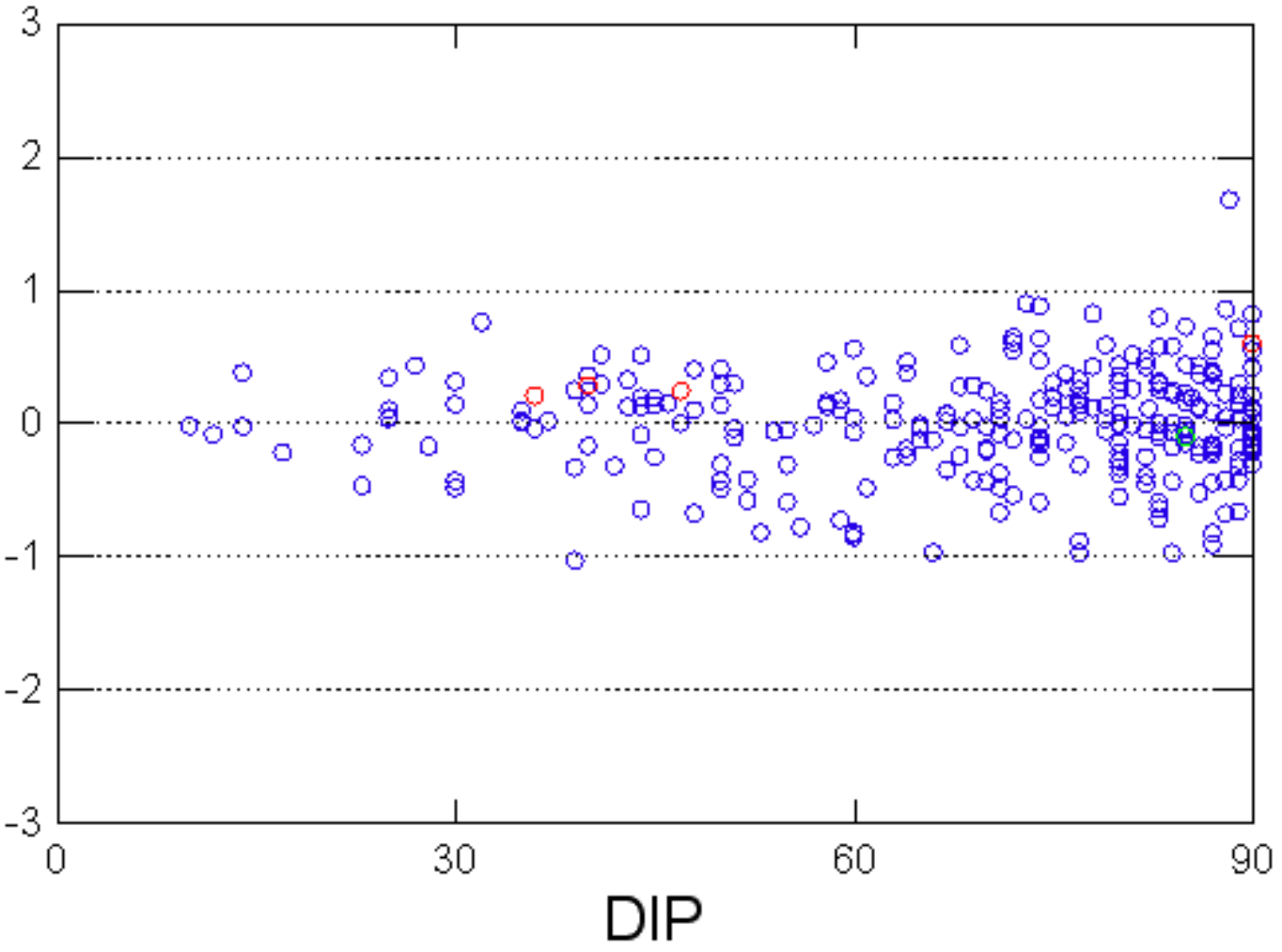
Between-Event vs. Magnitude



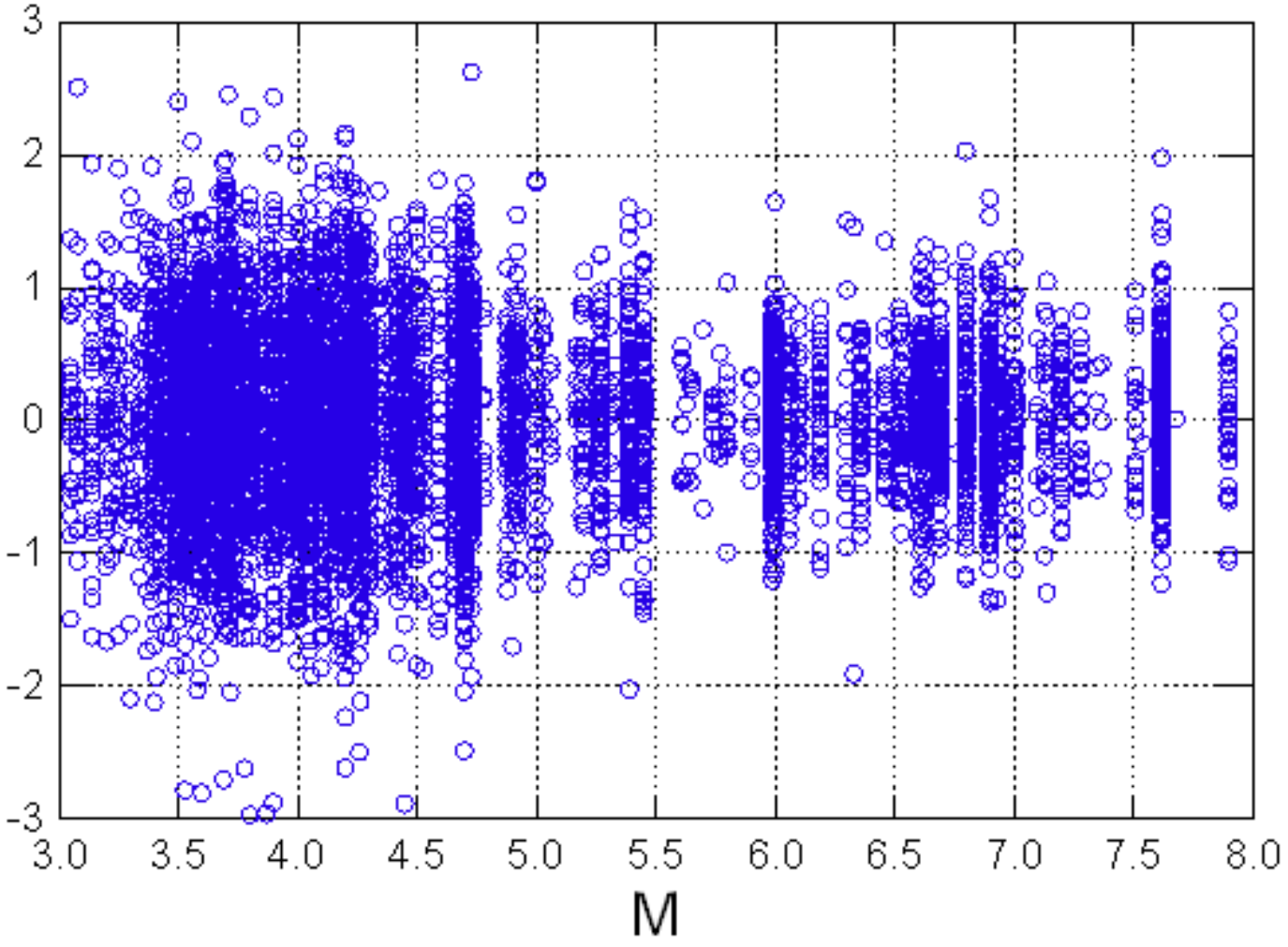
Between-Event vs. Depth



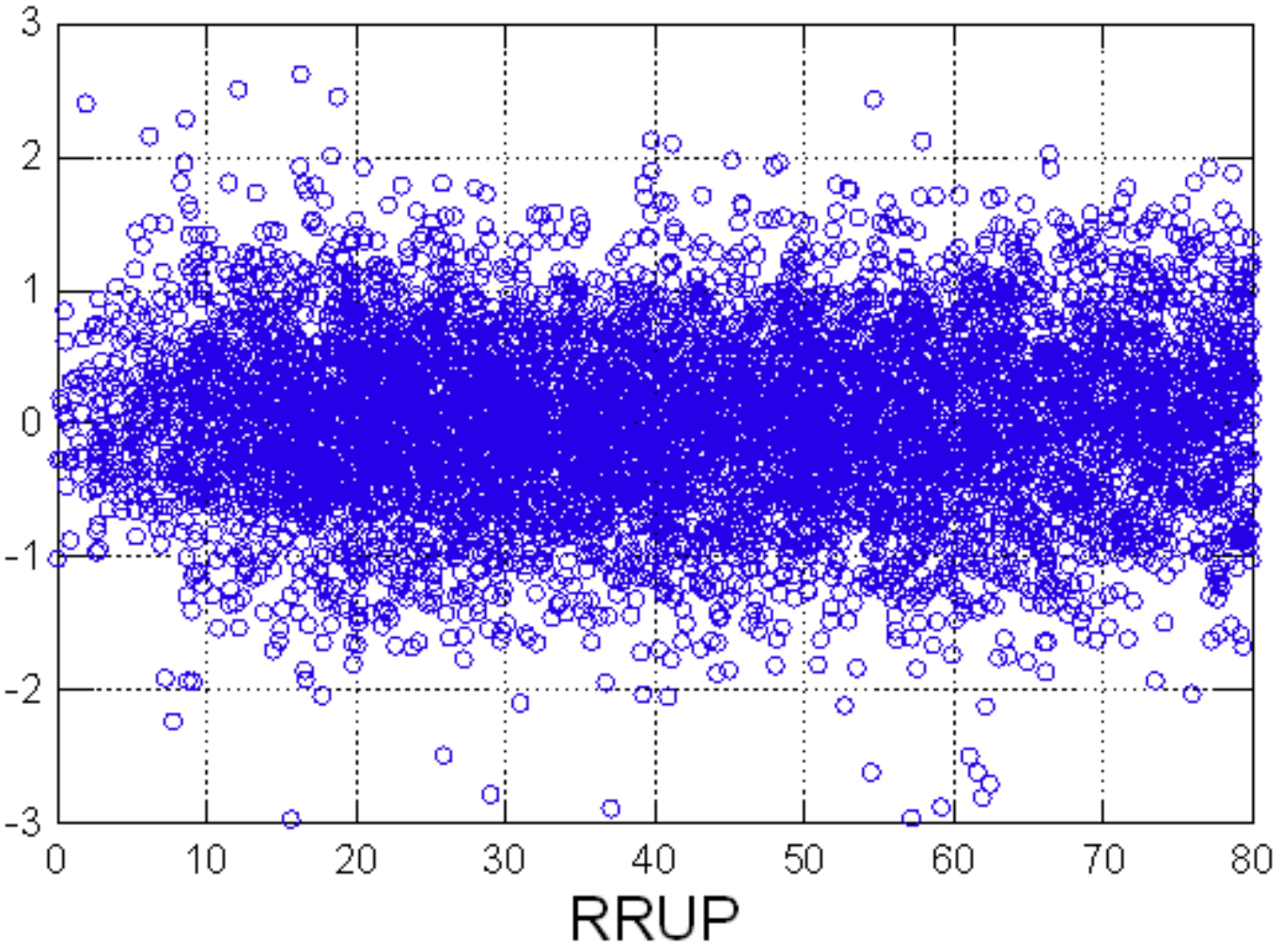
Between-Event vs. Dip



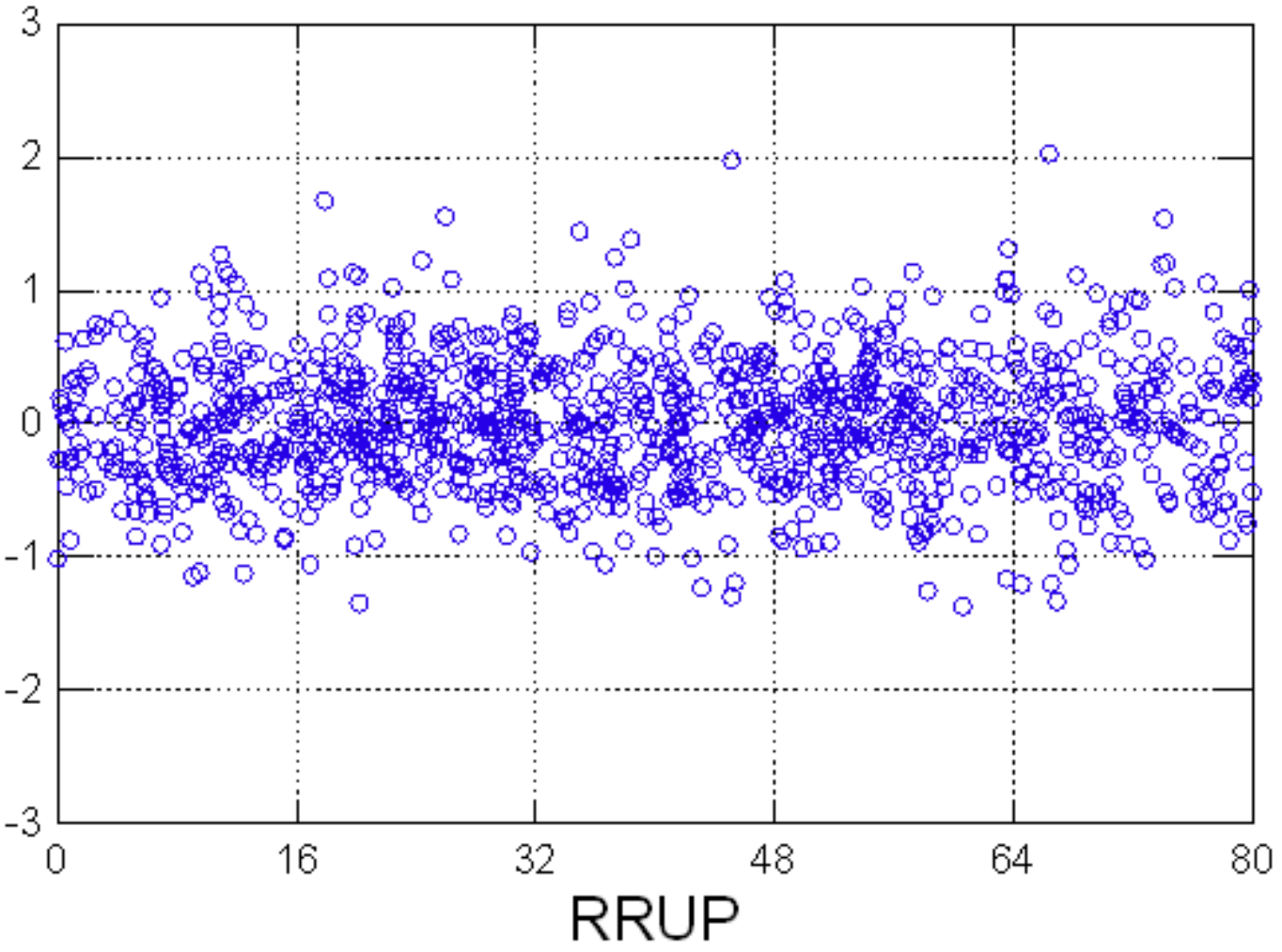
Within-Event vs. Magnitude



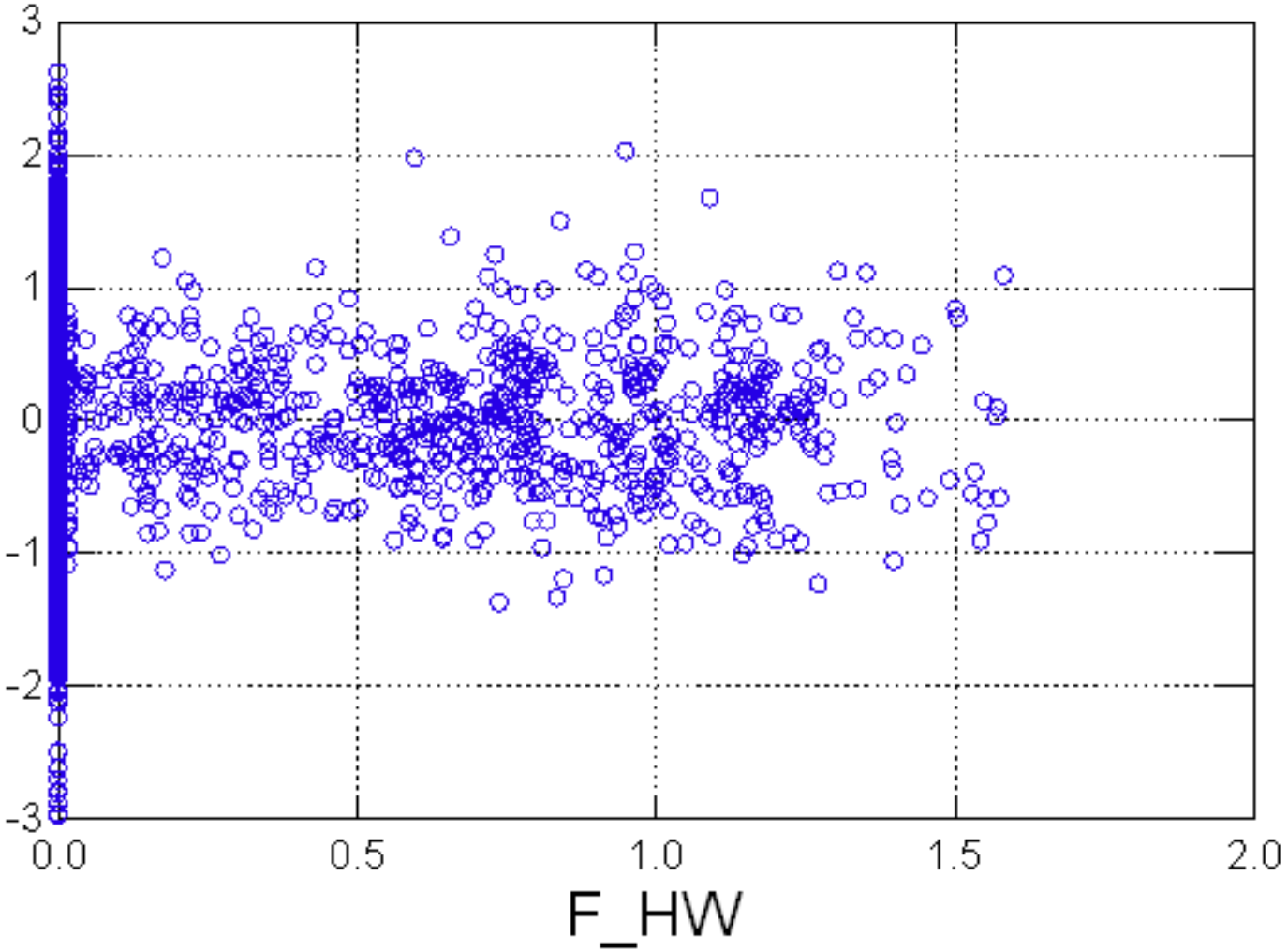
Within-Event vs. R_{RUP} (All **M**)



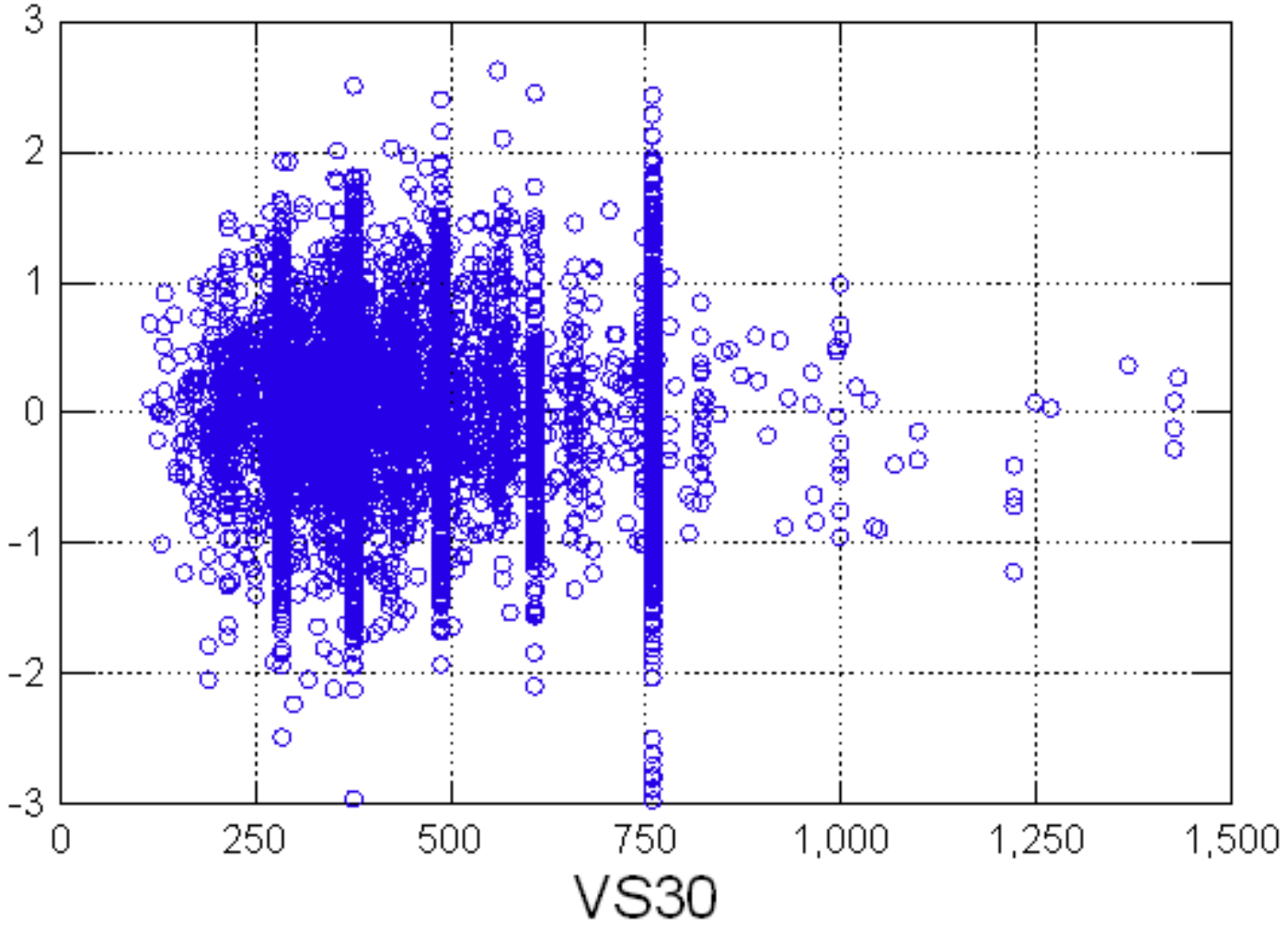
Within-Event vs. R_{RUP} (**M**>6.5)



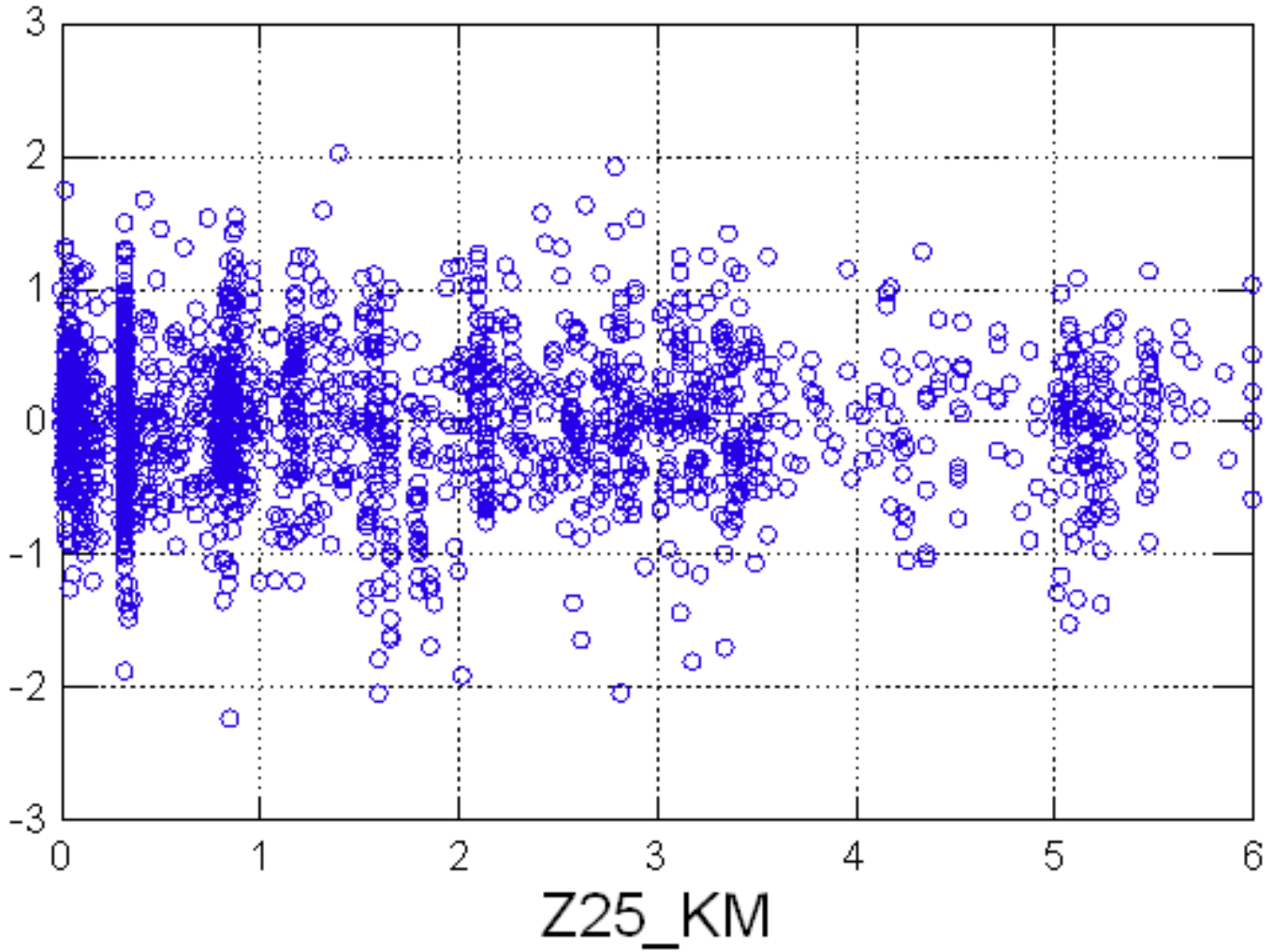
Within-Event vs. HW Term



Within-Event vs. V_{S30}

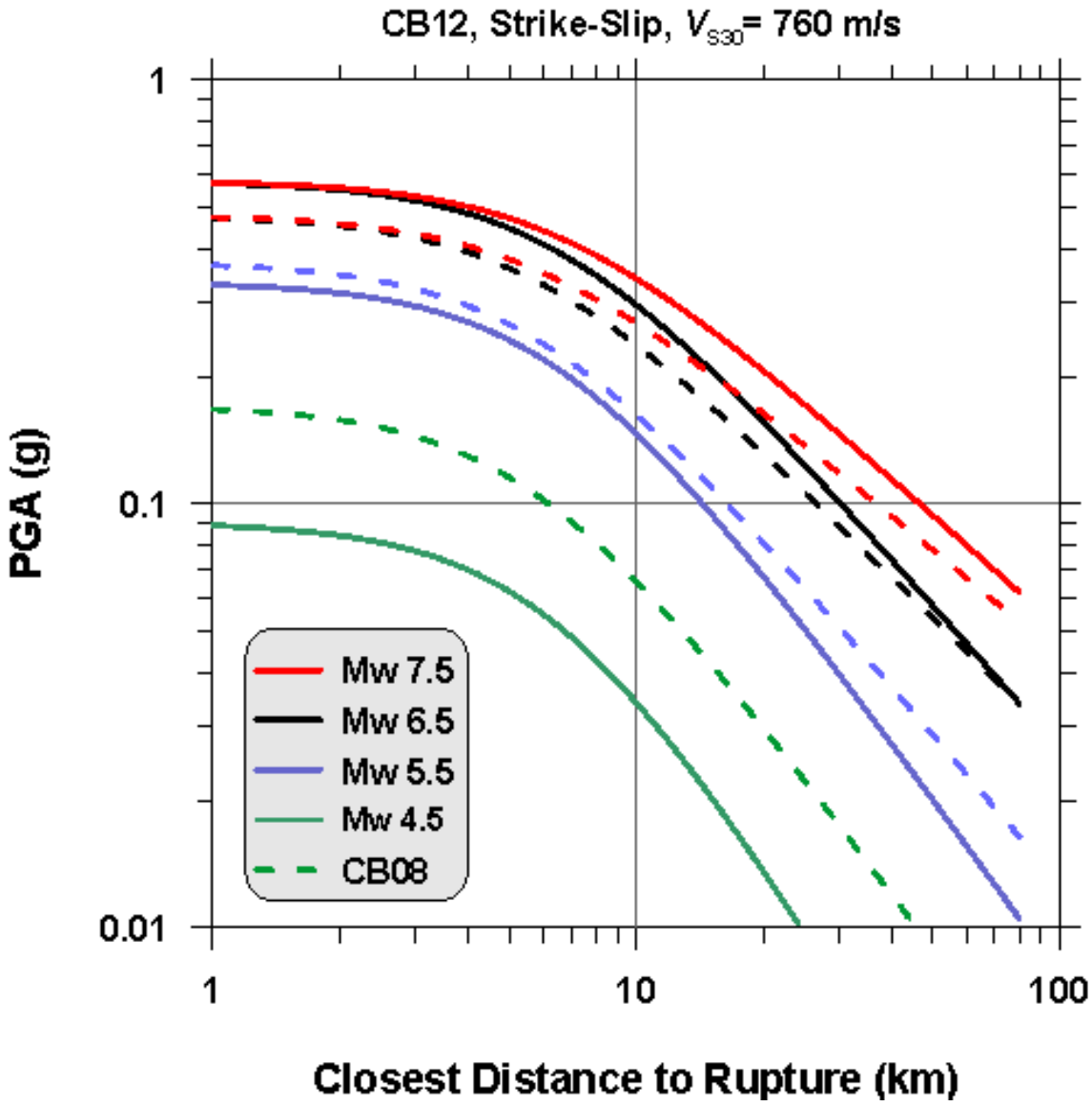


Within-Event vs. $Z_{2.5}$

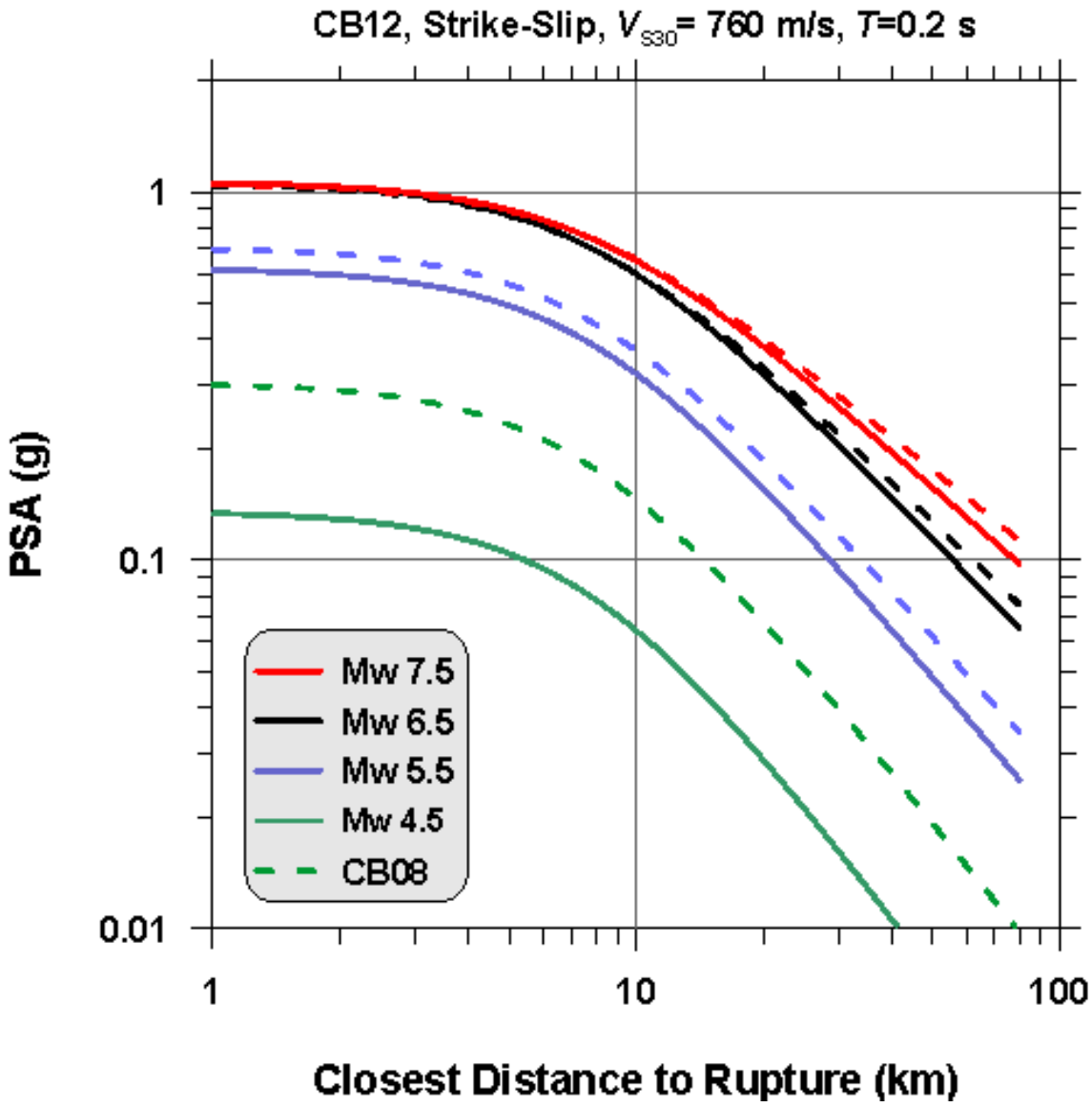


Comparison With 2008 NGA-West1 GMPE

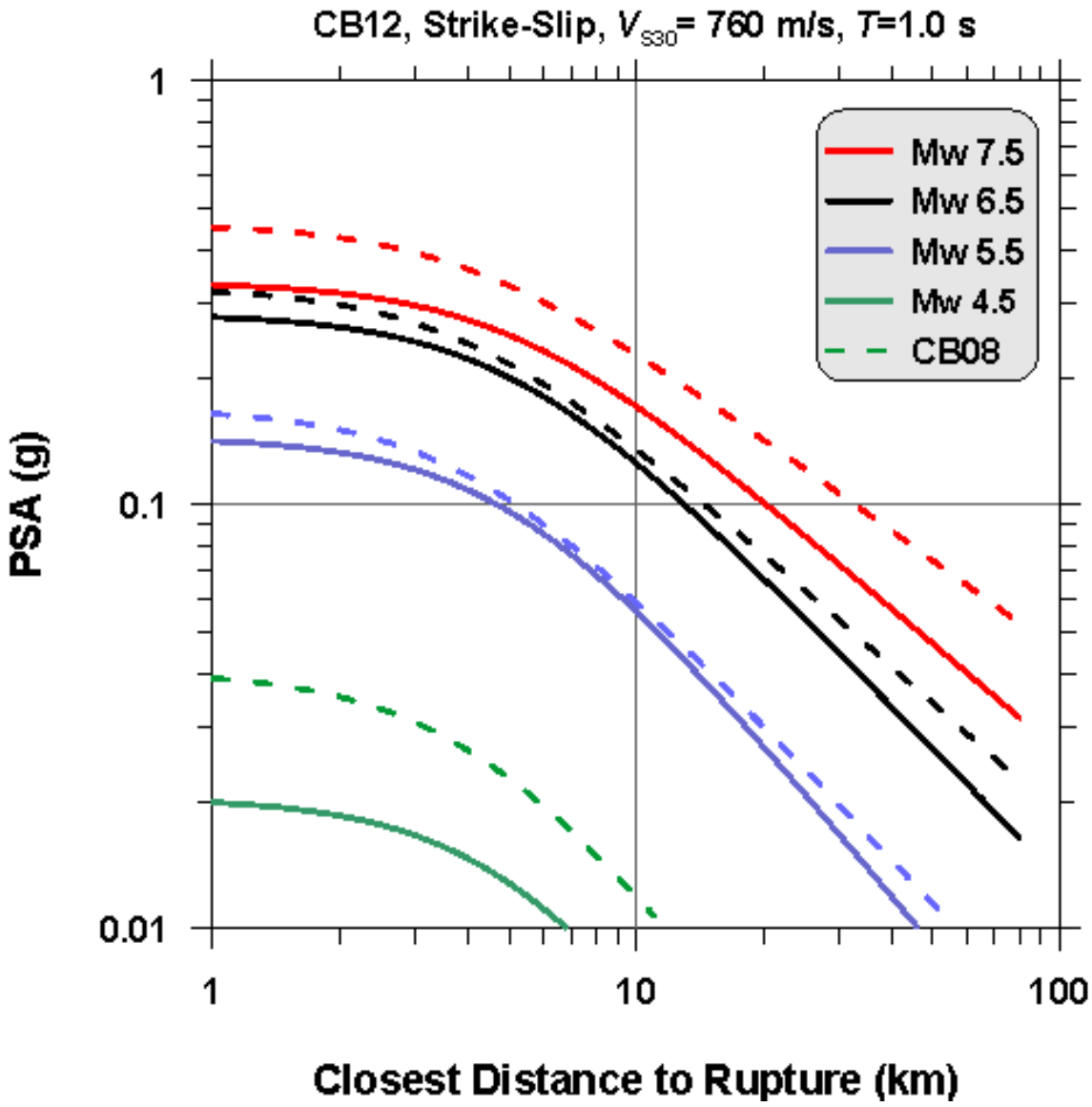
PGA, SS, Dip=90, V_{S30}=760



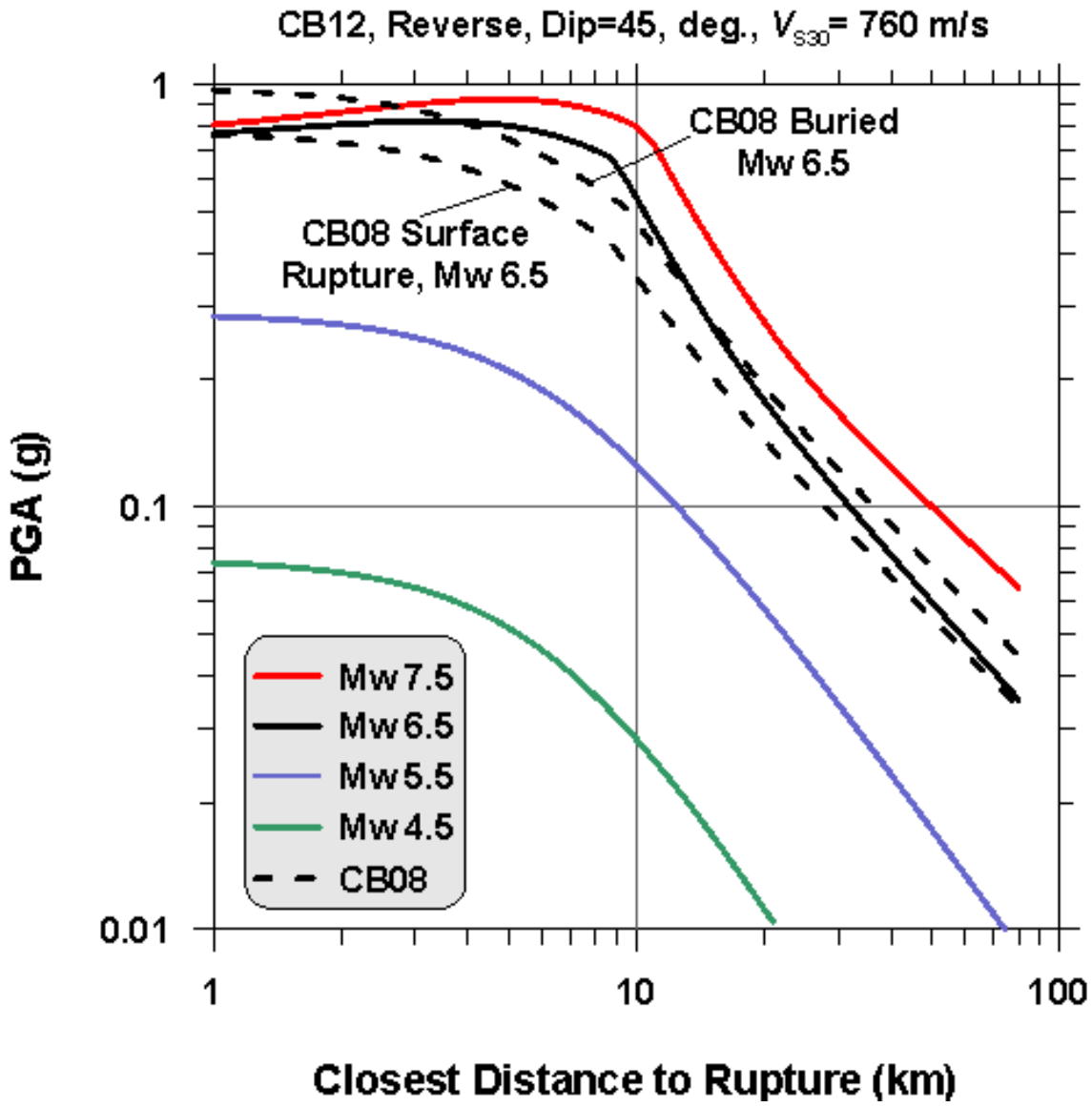
T=0.2s, SS, Dip=90, V_{S30}=760



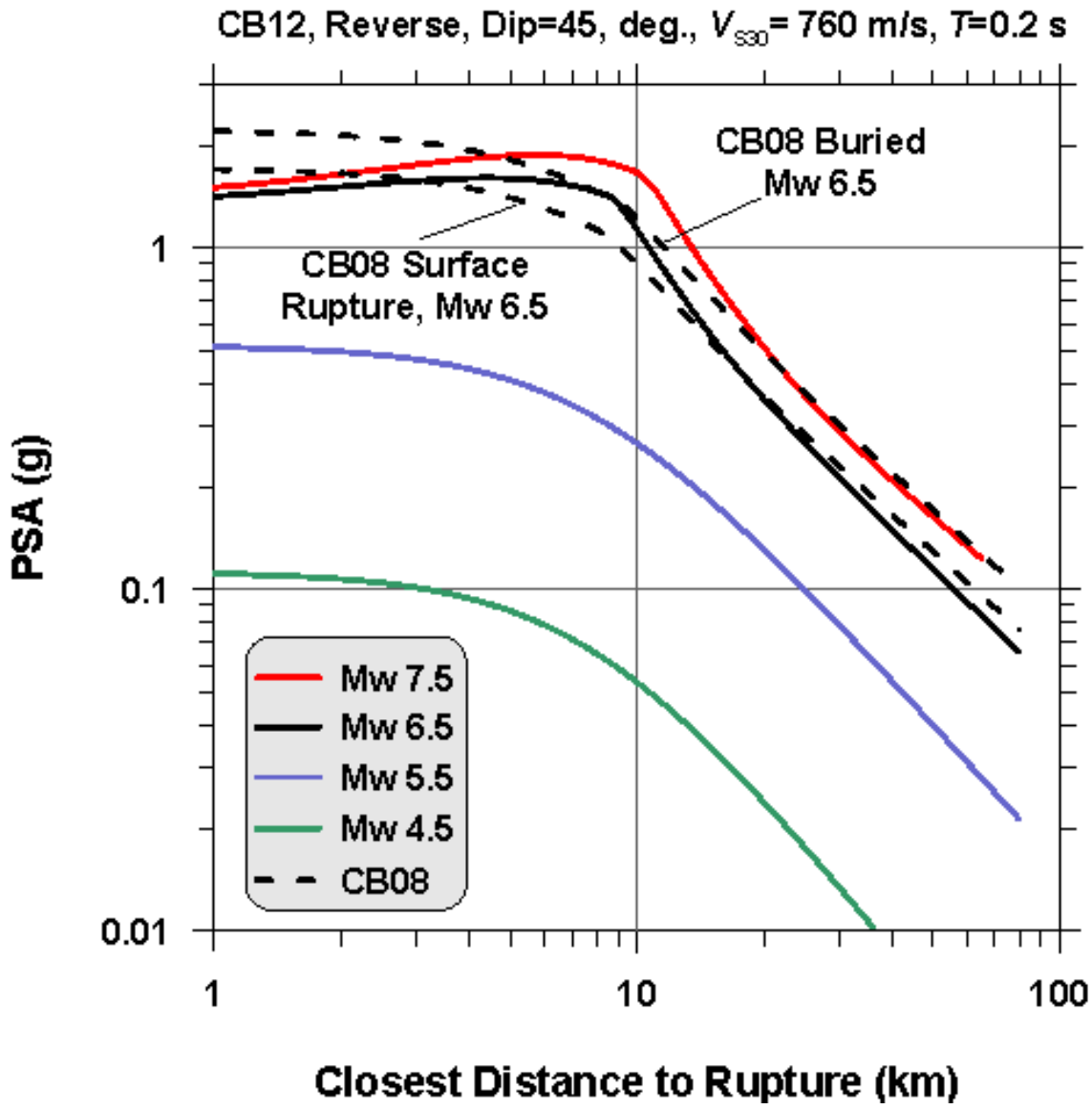
T=1s, SS, Dip=90, V_{S30}=760



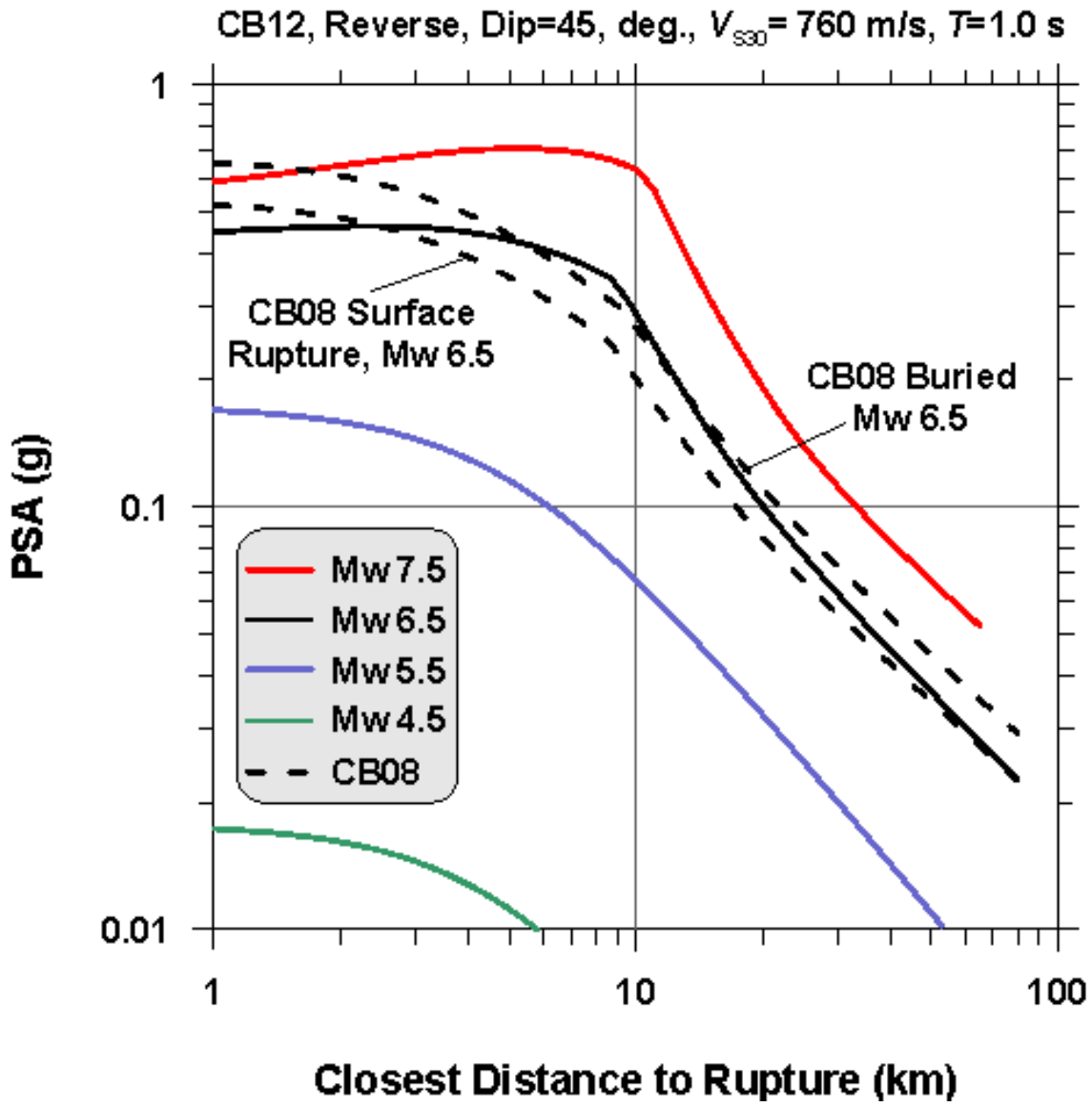
PGA, RV, Dip=45, V_{S30}=760



T=0.2s, RV, Dip=45, V_{S30}=760



T=1s, RV, Dip=45, V_{S30}=760



Work to be Completed by Project End

Work in Progress

- Evaluate and include effects of directivity
- Evaluate new nonlinear site term
- Add regional anelastic attenuation terms
- Magnitude-dependent standard deviation
- Develop vertical GMPE